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Does Big Data Tax Collection and Management Improve the Total Factor Productivity of Enterprises? ---Evidence Based on Quasi Natural Experiment of "Golden Tax phase III"

Lui Jingyi[1*] , He Dengjiao[2]

[1] Software English Institute of Guangzhou, Department of Finance and Economics, Guangzhou, China

[2] School of Economics, Guangzhou City University of Technology, Guangzhou, China

* E-mail: ljy@mail.seig.edu.cn

Abstract: In the era of digital economy, as one of the important means for the country to promote the modernization of the governance system and governance capacity in the field of tax collection and management, the “Golden Tax Phase III” big data tax collection and management system has had a positive impact on the total factor productivity of the manufacturing industry. Taking A-share listed manufacturing companies from 2010 to 2019 as a research sample, and using the "Golden Tax Phase III" tax collection and management system as a quasi-natural experimental scenario, this paper empirically tests the impact of big data tax collection and management on the total factor productivity of enterprises. The study found that the improvement of the level of big data tax collection and management has significantly improved the total factor productivity of enterprises. Exploring its influence mechanism found that big data tax collection and management can improve the total factor productivity of enterprises by stimulating technological innovation of enterprises. The article enriches the research on the policy consequences of big data collection and management, and also provides important empirical data support for government departments to continue to promote and improve the golden tax phase IV.

Keywords: Big data tax collection and management; Total factor productivity; Enterprise innovation; Natural experiment; Differences-in-differences

1 Introduction

The era of big data has benefited from the progress of China's Internet technology and the growing maturity of cloud storage and computing frameworks cloud storage and computing framework. The Report of the 19th National Congress of the CPC proposed to make full use of big data and other modern information technologies to accelerate the construction of intelligent taxation, deepen the sharing and application of taxation big data, and move up the modernization level of national governance. The "Golden Tax phase III" big data tax collection and management system is not only an important means of using information technology to promote the modernization of state governance, but also an important tactic in response to the China's "Reform of Government Functions".Therefore, with the full operation of the big data tax collection and management system of "Golden Tax Phase III", a large number of studies have begun to focus on the policy effects of the economic consequences of big data tax collection and management. A large number of empirical studies have found that big data tax collection and management can significantly improve enterprises' tax compliance [1], significantly improve the quality of enterprises' financial reports, and not only enhance tax enforcement, but also reduce enterprises' tax avoidance [2]. Jiang Xuanyu (2013) and Xu Hanjun (2021) empirically tested that big data tax collection and management can significantly suppress the risk of stock price collapse of listed companies[3][4]. Sun Xuejiao et al. (2021) concluded that big data tax collection and management reduces the degree of corporate earnings management[5].

At the same time, the report of the 19th Party Congress emphasises the need to promote quality, efficiency and power changes in the economy, improve total factor productivity and transform China's economy from high growth to high quality development. The improvement of total factor productivity depends on technological progress, organisational innovation and rational allocation of resources[6]and is supported by empirical evidence. Investment in technological development and technological transformation can significantly affect the total factor productivity of large and medium-sized industrial enterprises in China[7]. The external environmental factors of enterprises, such as industrial agglomeration[8], import and export trade[10], and government subsidies[12] also affect the total factor productivity of enterprises. However, little attention has been paid to whether tax collection and administration, as

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one of the external governance environments of enterprises, will have an impact on the total factor productivity of enterprises.

Therefore, this paper attempts to use the "Golden Tax Phase III" in batches nationwide to fully implement this quasi-natural experiment scenario, examine the impact of the big data tax collection and management system on the productivity of enterprises, test the policy effect of big data tax collection and management, and try to answer the question: (1) Does the big data tax collection system increase the total factor productivity of enterprises?(2) What are the specific paths through which big data tax administration affects the total factor productivity of enterprises?

2 Theoretical analysis and hypothesis

Big data tax collection and management, as one of the external governance environments of enterprises, has governance effects and taxation effects[13]. From the perspective of governance effects, enhancing the intensity of tax levy can improve information asymmetry and agency problems, compensate for the insufficiency of internal and external corporate governance mechanisms, and thus improve business efficiency[14]. Liao Xinxin and Liu Yunguo showed that with the strengthening of internal and external supervision of enterprises, the positive correlation between corporate tax avoidance activities and management's on-the-job consumption has been effectively weakened. It alleviates agency conflicts between controlling shareholders and creditors, reduces the behavior of major shareholders occupying listed companies' funds and related transactions between listed companies, suppresses management's encroachment on shareholders' interests, and reduces major shareholders' hollowing out of enterprises[15]. Therefore, tax collection and management not only regulates the taxation behavior of enterprises, but also promotes enterprises to obtain more debt financing by reducing agency costs, improves the financing environment of enterprises, and provides good external support for enterprises to invest in innovation[16]. Tax collection and management also improves the innovation by reducing the self-interest of managers and discouraging controlling shareholders from hollowing out[17]. From the perspective of taxation effect, the taxation effect of big data tax collection and management and the constraints on corporate tax avoidance increase corporate tax burden and have an impact on corporate business behavior [13]. Facing the external supervision mechanism of big data tax collection and management, in order to improve

their competitiveness, enterprises have to adjust their own behavior, seek reasonable cost reduction paths, and prompt enterprises to increase investment in technological innovation. Because innovation can enable enterprises to gain an advantage in the fierce competition and ensure the continuous improvement of enterprise profitability, thereby alleviating the burden and pressure of tax burden.

In addition, Golden Tax phase III can effectively help enterprises to implement the preferential tax policies to "enjoy what they deserve"[18]. The taxation authority has sent a signal to enterprises by optimizing tax payment services and promoting the implementation of preferential tax policies. That is to say, although tax collection and management increase the tax avoidance cost of enterprises, enterprises can choose more innovation investment to obtain more tax incentives to obtain legal and reasonable tax reduction. The impact of increased tax burden brought about by sales tax collection and administration, and the benefits of innovation can also be obtained. At this time, strong tax collection and management and preferential tax policies have produced a synergistic effect on corporate innovation investment.

Endogenous growth theory believes that innovation is the fundamental source of improving total factor productivity, and the improvement of the level of enterprise R&D innovation can directly improve the total factor productivity of enterprises. Enterprises with higher innovation quality generally have better resource allocation efficiency, and can use existing resources to maximize value creation, which in turn has a positive effect on the total factor productivity of enterprises[19]. A large amount of empirical evidence also shows that innovation capability and innovation mode are the main enterprises affecting total factor productivity[20]; R&D investment significantly promotes the improvement of firms' factor productivity[21].

Based on the above analysis, this paper draws the following assumptions:

Restricting other conditions unchanged, big data tax collection and management has improved the total factor productivity of enterprises.

3 Research design

3.1 Data sources and sample selection

This paper selects a-share manufacturing listed companies in Shanghai and Shenzhen listed companies from 2010 to 2019 as the research sample for the study,

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with data relating to the sample companies sourced from China Stock Market & Accounting Research Database (CSMAR) and the RESSET Database(RESSET). This paper excludes sample companies with missing data, ST and companies with other special circumstances. Winsorize the 1% and 99% quantiles for continuous variables, and finally get 10718 valid observation sample data.

3.2 Model construction and variable definition

3.2.1 Explained variable

Referring to the methods of Guo Qingwang, Jia Junxue (2005), Wang Bingrui, Yan Pengfei (2010), Yang Rudai (2015), etc., the LP method is used to measure the total factor productivity of enterprises[22][23][24]. The natural logarithm of fixed assets, adjusted by the fixed asset price index, is used as a measure of capital input; the natural logarithm of the number of employees is used as a measure of labour input. use the natural logarithm of the number of employees in an enterprise is used as a measure of labor input.

3.2.2 Explanatory variable

In 2013, the first batch of provinces and cities where the "Golden Tax phase III" system went online included Chongqing, Shandong and Shanxi; the next batch of provinces and cities where the system went online included Guangdong, Henan and Inner Mongolia Autonomous Region; in 2015, the third batch of the system went online in 14 provinces and autonomous regions, including Jilin, Hainan and Tibet. After 2016, the "Golden Tax phase III" has entered a comprehensive promotion stage——it will be fully applied in 16 provinces including Beijing, Shanghai, and Tianjin. Defining big data tax collection and management implementation variables borrows the practice of Xu Hanjun (2021) to construct Treat_Dumet dummy variables[4]. When province “I” goes online with the “Golden Tax phase III” system in year “t”, the dummy variable Treat_Dumet takes the value of 1, otherwise it takes 0.

3.2.3 Control variable

With reference to existing studies on the factors influencing total factor productivity ofenterprises, the relevant control variables at the firm level have been selected as shown.

The "Golden Tax phase III" big data tax collection and management system based on this study is carried out step by step in batches and stages. In order to test the effect of policy implementation before and after multiple time points, this paper draws on existing research[25]. Using the multi-period double difference method to test the impact of big data tax collection and management on the factor productivity of manufacturing enterprises. The specific model is as follows:

$$TFPi,t=\alpha0+\alpha1Treat\_Dumei,t+\alpha2Controli,t+\mu t+Vi+\varepsilon i \quad (1)$$

Among them, the variable subscript i represents the company, t represents the time, and TFPi,t represents the total factor production of the ith company in the t year. Treat_ Dumei, t take 1 when the sample i company is in the year after the implementation of the policy of a certain province or city, otherwise take 0 to construct a multi-period difference-in-differences model to test the research hypothesis. Control represents the set of series control variables, μt and Vi represent unobservable time fixed effects and city fixed effects, εit is the stochastic error term, α0 represents the constant term.

3.3 Descriptive statistics

Table 2 Reports the results of the descriptive statistics of the main variables studied.

It can be seen from Table 2 that the sample total factor productivity has a mean value of 6.7927 and a standard deviation of 2.1603, which is similar to the results of Hu Ridong et al.'s (2021) total factor productivity based on Shanghai and Shenzhen A-share listed manufacturing companies[26]. The maximum and minimum values are 10.4316 and 3.7199, the range of variation is relatively large, indicating that there is a significant gap in total factor productivity among manufacturing enterprises; the core explanatory variable Treat_Dume and the descriptive statistical results of Xu Hanjun (2021) and other documents are basically consistent and within a reasonable range[4].

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4.1 Results of empirical testing of the main research hypotheses

It reports the empirical results of the main hypotheses studied in this study. The regression results in column (1) show that the implementation policy coefficient of the “Golden Tax phase III” under the LP method is 0.080, which is significant above the 1% level, which indicates that the launch of the big data tax collection and management system has improved the total factor productivity of enterprises. In other words, compared with listed companies that have not implemented the "Golden Tax phase III" collection and management system, listed companies that have implemented the "Golden Tax phase III" collection and management system have higher total factor production. This shows that the big data tax collection and management system, as the external governance environment of the enterprise, has exerted a governance effect and significantly improved the total factor productivity of the enterprise, which verifies the hypothesis of this paper, and the results of other control variables also show that significantly correlated with total factor productivity[13].

In order to further analyze the impact of the "Golden Tax phase III" tax collection and management system on total factor productivity, and to ensure the robustness of the research conclusions, the Hausman test is used. Column (2) reports that the fixed effect model is better, showing that there is a 1% positive correlation between the “Golden Tax phase III” collection and administration system and total factor productivity; The report in column (3) uses a random effect test to control for related variables such as time and city effects, and shows that the “Golden Tax phase III” collection and management system is still positively correlated with total factor productivity at a rate of 1%. The results of the study It is consistent with the empirical regression results under the first two methods, indicating the robustness of the conclusions of this paper.

Note: ① The values in parentheses are the Z statistics of a single explanatory variable, * * * , * * , and * indicate that the coefficients are significant within the 1%, 5%, and 10% confidence intervals, respectively, as below.

② “—” means that this variable is not included in this model, as below.

4.2 Further analysis

Because of the different provinces have differences in geographical location, industrial structure and economic development status, the impact of the implementation of the "Golden Tax phases III" system on total factor productivity may have regional differences in the spatial dimension, so we conducted separate regressions with sample data from the east, central and western regions, and the specific heterogeneity analysis results are shown.

The heterogeneity regression results show that the implementation of the "Golden Tax phase III" big data collection and management system has different effects on the total factor productivity of enterprises in different regions. Its promotion effect on manufacturing total factor productivity mainly comes from the eastern region of China, not significant for western China, and has a negative impact on the enterprises in the central China.

The possible reasons for this are that eastern China, with its high degree of marketization and developed manufacturing industries, is more receptive to the standardized tax collection and administration practices of the "Golden Tax III" big data collection and administration system, and that a sound property rights protection system provides a protection mechanism for the transformation of innovation output into productivity, and the improvement of tax collection and management level has a more obvious role in stimulating enterprises to invest in innovation. Therefore, it is easier to improve the total factor productivity of enterprises[21].

In contrast, the western region of China has experienced rapid growth in total factor productivity in its manufacturing industry due to the support of national policies, the introduction of new technologies and the improvement of management methods, and in general the growth rate is greater than that of the central and eastern regions[17]. In particular, from 2012 to 2016, the centre of gravity of total factor productivity in China's manufacturing industry increased rapidly due to the significant technological spillover effect of the northwestern region taking over the transfer of manufacturing industries from the eastern and western regions, with a significant increase in technological innovation and translational application[28]. Therefore, the impact of the standardisation of the tax collection system on the total factor productivity of enterprises shows no effect on the basis of its own relatively large growth.

The implementation of the "Golden Tax phase III" big data collection and management system has a significant negative impact on the total factor productivity

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of the central region at the level of 10%. The possible reason is that the development of the manufacturing industry in the central region is less developed than that in the eastern region. During the period of rapid development, there is a large demand for funds, and the "tax effect" formed by the implementation of the "Golden Tax phase III" big data collection and management system is more obvious than its "governance effect", which may cause enterprises to be temporarily in a state of financing constraints[21], therefore, the total factor productivity of enterprises will be negatively affected.

By comparing the regression results of the three major regions in the eastern, central and western regions as a whole, we can find that the implementation of the "Golden Tax Three-phase" collection and administration system in the eastern region has the greatest impact on total factor productivity, the central region has a negative correlation, and the western region is not obvious, obeying the order of decreasing in the east, middle and west. The trend shows that the more developed the manufacturing area is, the more obvious the promotion effect of big data tax collection and management on total factor productivity.

4.3 The mechanism of the big data tax collection and management system affecting the total factor productivity of enterprises

As mentioned above, big data tax collection and management systems can improve the total factor productivity of enterprises by stimulating enterprises to innovate. Therefore, based on the empirical test results of the main research hypothesis, this paper further tests whether the big data tax collection and management system improves total factor productivity by stimulating enterprise innovation. It is generally believed that tax collection and management can reduce the self-interested behavior of managers, inhibit the hollowing out of holding investment, and improve the innovation level of enterprises[17]. Then ,the result of enterprise innovation is to directly lead to the improvement of total factor productivity. As can be seen, the column (1) shows that the gross effect of Treat_Dumei,t on TFP is 0.076. After adding IN1 (utility models and designs), the coefficient of Treat_Dumei,t drops from 0.076 to 0.063, and is significant at the 1% level, indicating that there is a partial intermediate effect between tax collection and management and total factor productivity for utility models and designs. When replacing IN1 with the number of inventions, the effect of Treat_Dumei,t on

TFP decreased from 0.076 to 0.060, which was also significant at the 1% level. Both IN1 and IN2 passed the Sobel test, with the former having a mediating effect of 20.74% and the latter having a mediating effect of 26.67%. This shows that the big data tax collection and management system leads enterprises to actively shrink various tax avoidance activities, and improves the total factor productivity of enterprises by improving the innovation level of enterprises. This is consistent with the previous assumption.

5 Robustness test

To ensure the robustness of the conclusions of this paper, this paper adopts the OP method to re-measure the total factor productivity of enterprises. It shows that the impact of the "Golden Tax phase III" on the total factor productivity of enterprises remains unchanged, with a positive correlation at the 1% level. Therefore, the model and conclusions used in this paper are relatively robust.

6 Conclusion and policy revelation

This paper takes a-share manufacturing listed companies in Shanghai and Shenzhen from 2010 to 2019 as a sample, and takes the “Golden Tax Phase III” big data tax collection and management system as a quasi-natural experiment, we use a combination of multiple difference and mediation effects to study the impact of the big data tax collection system on the total factor productivity of the manufacturing industry.The results show that the big data tax collection and management system has significantly improved the total factor productivity of enterprises, and the mechanism found that the taxation effect generated by the big data tax collection and management system and the constraints on the tax avoidance behavior of enterprises increased the tax burden of enterprises. An external monitoring mechanism increases investment in innovation, which leads to an increase in the total factor productivity. The results of heterogeneity analysis show that the promotion effect of big data tax collection and management system on the total factor productivity of enterprises is mainly reflected in the more developed manufacturing areas in the east of China.

Based on the above conclusions, this paper proposes: First, the development of an enterprise is affected by both corporate governance and its own conditions, as

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well as by external supervision mechanisms. Therefore, in the face of the continuous improvement of the external governance environment, such as when the “Golden Tax phase IV” collection and management system with more powerful functions than the “Golden Tax phase III” is launched, it should further increase investment in technological innovation and strive to improve technological innovation capabilities. Actively respond to the negative impact brought by the strengthening of tax collection and management to enterprises through technological innovation.Secondly, big data tax collection and management has a significant positive impact on the total factor productivity of enterprises, which also suggests that the government should continuo to improve tax supervision on the basis of the existing "Golden Tax Phase III" tax management system, give full play to its corporate governance effect, and improve total factor productivity of enterprises.

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